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Original Research Paper

Anatomy

MORPHOMETRIC ANALYSIS OF DISTAL END OF HUMAN ADULT DRY FEMUR IN NORTH INDIAN POPULATION

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ABSTRACT **Introduction:** The distal end of the femur is a key element of the knee joint. Precise morphometric anatomical data of the distal femur and gender-specific morphometric variations are crucial for the design of complete knee joint replacements and internal fixation devices. Knee prostheses designed using morphometric data of the femur and tibia, tailored to gender, will yield improved outcomes in early mobility and reduced problems. **Materials and Methods:** The present study was conducted among 60 dry femur. 30 male (15 right, 15 left) and 30 female (15 right, 15 left). Morphometric parameters like Bicondylar width (BCW), Medial condylar anteroposterior distance (MCAPD), Lateral condylar antero-posterior distance (LCAPD), Medial condylar transverse distance (MCTD),Lateral condylar transverse distance (LCTD) and Intercondylar notch width (ICW) were studied. **Result:** There was a significant difference of Morphometric measurements of the lower end of the femur between male and females. (P value <0.05) **Conclusion:** This study provides direct observational data on measurements of the distal femur, facilitating the selection of the suitable prosthesis. Our data about gender and lateralisation will improve prosthesis durability, mobility, and quality of life for patient's knee replacement surgery.

KEYWORDS : Dry Femur, Morphometry, Knee prosthesis

INTRODUCTION

The complex synovial knee joint has tibiofemoral and patellofemoral articulations. In daily life, it controls body mass and posture. This requires a wide three-dimensional range of motion and strong force resistance.[1] Only the interplay between articular surfaces, passive stabilisers, and cross-joint muscles achieves these contradictory mobility and stability criteria.[2]

Osteoarthritis of the knee increases with age and obesity. Osteoarthritis is painful and impairs daily life. Knee replacement or arthroplasty helps severe osteoarthritis patients. This operation relies on appropriate prosthetic size, selection, and component placement.[3,4]

The distal femur anatomy affects total knee replacement, which seeks to return its morphology to normal. Radiography, computerised tomography, and magnetic resonance imaging have measured morphology. After addressing magnification, technique, and projection, indirect approaches remain incorrect.[5-8]

To develop complete knee joint replacement and internal fixation materials, accurate morphometric data of the lower end of the femur and gender differences are crucial. A mismatch between morphometric data and prosthesis can lead to issues such as anterior cruciate ligament rupture, soft tissue imbalance, reduced knee movement, and implant loosening. A knee prosthesis based on morphometric data of the femur and tibia, as well as gender, can improve early mobility and reduce problems.[9]

Traditional prostheses are for Caucasians. North Indians have smaller bodies than Caucasians. The ideal knee prosthesis for North Indians can be designed utilising measurements and guidelines. This ensures long-term prosthesis use. Few data exist on dry femur studies conducted through direct observations.[10] We conducted morphometric analysis on the lower end of dry femur by gender. Data will provide gender-specific measures of the lower end of the femur throughout India, particularly in the eastern region, before knee replacement procedures.

Objectives

1. To study Morphometric parameters of lower end of femur.
2. To study sexual dimorphism in lower end of femur in Northern India.

MATERIALS AND METHODS

The present study was conducted among 60 dry femur. 30 male (15 right, 15 left) and 30 female (15 right, 15 left) in the department of Anatomy of M.L.N. Medical College, Prayagraj. Only complete and fully ossified bones were included and bones showing damage, deformity or arthritic changes were excluded from the study.

Following parameters were measured with the help of digital vernier calliper.

Bicondylar Width (BCW): The maximum distance across femoral condyles in transverse plane.

Medial Condylar Antero-posterior Distance (MCAPD): The maximum anteroposterior distance of medial femoral condyle.

Lateral Condylar Antero-posterior Distance(LCAPD): The maximum anteroposterior distance of lateral femoral condyle.

Medial Condylar Transverse Distance (MCTD): The maximum transverse distance of medial femoral condyle.

Lateral Condylar Transverse Distance (LCTD): The maximum transverse distance of lateral femoral condyle.

Intercondylar Notch Width (ICW): The maximum distance of intercondylar notch between two condyles posteriorly.

All measurements were taken by single author for consistency. All the measurements for right and left femur were recorded separately. The data was recorded in MS Excel Sheet and analysed using SPSS Software version 22 for mean and SD. Independent t test was used to calculate the differences in the parameters of right and left femur. The p-value <0.05 was considered statistically significant.

RESULT

The Mean Bicondylar width (BCW) was 70.71±2.07 (74.57±1.91 mm among males, 66.85±2.23 mm among females). Mean Medial condylar antero-posterior distance (MCAPD) was 55.63±2.31(57.59±2.75 mm among males, 53.67±1.87 mm among females). Mean Lateral condylar antero-posterior distance (LCAPD) was 56.92±2.47 (59.29±2.72 mm among males, 54.32±2.23 mm among females). Mean Medial condylar transverse distance (MCTD) was 29.44±1.56 (31.13±1.52 mm among males, 27.75±1.6 mm among females). Mean Lateral condylar transverse distance (LCTD) was 30.19±1.43 (31.93±1.51 mm among males, 28.45±1.36 mm among females). Mean Intercondylar notch width (ICW) was 19.97±2.26 (20.71±2.08 mm among males, 19.24±2.44 mm among females).There was a significant difference of Morphometric measurements of the lower end of the femur between male and females. (P value <0.05).

Table 1: Morphometric Measurements Of The Lower End Of The Femur (n=60)

Parameters (mm)	Side	Male (Mean ±SD)	Combined Male (Mean ±SD)	Male (Mean ±SD)	Combined Female (Mean ±SD)	P Value
BCW	Right	74.53 ± 1.6	74.57 ± 1.91	67.34 ± 1.7	66.85 ± 2.23	<0.0001
	Left	74.62 ± 2.23		66.37 ± 2.76		
MCAPD	Right	57.32 ± 2.38	57.59 ± 2.75	52.86 ± 1.58	53.67 ± 1.87	<0.0001
	Left	57.86 ± 3.12		54.48 ± 2.17		
LCAPD	Right	58.48 ± 3.11	59.29 ± 2.72	54.78 ± 1.68	54.32 ± 2.23	<0.0001
	Left	60.11 ± 2.34		53.87 ± 2.78		
MCTD	Right	30.86 ± 1.6	31.13 ± 1.52	27.6 ± 1.8	27.75 ± 1.6	<0.0001
	Left	31.4 ± 1.45		27.91 ± 1.41		
LCTD	Right	31.43 ± 1.8	31.93 ± 1.51	28.35 ± 1.35	28.45 ± 1.36	<0.0001
	Left	32.03 ± 1.23		28.56 ± 1.37		
ICW	Right	20.23 ± 2.73	20.71 ± 2.08	18.33 ± 2.3	19.24 ± 2.44	<0.01
	Left	21.2 ± 1.43		20.16 ± 2.58		

P value <0.05 is statistically significant, T test applied

DISCUSSION

The majority of morphometric investigations utilise measurements obtained using radiographs, CT scans, or magnetic resonance imaging techniques, which are considered indirect approaches. Studies indicate that indirect measurement methods are often erroneous and imprecise, despite being rectified by projection techniques and resolutions.

The direct method of measurement is advantageous compared to indirect methods, as it provides precise morphometric data. The accuracy of the direct measurement method allows us to align morphometric data for prosthesis fabrication in joint replacement surgery with the resected knee surface, thereby enhancing the long-term success of the prosthesis and reducing complications in total knee joint replacement.

Parameters (mm)	Present study	Zalawadia AZ et al11	Biswas A et al12	Neelima P et al13
BCW	70.71 ± 2.07	70.81 ± 2.22	71.21 ± 4.87	-
MCAPD	55.63 ± 2.31	55.7 ± 2.19	53.85 ± 3.81	57.83 ± 0.69
LCAPD	56.92 ± 2.47	56.92 ± 2.51	56.12 ± 3.82	58 ± 0.51
MCTD	29.44 ± 1.56	29 ± 2.65	26.38 ± 2.17	21.33 ± 0.43
LCTD	30.19 ± 1.43	30.26 ± 1.44	27.9 ± 2.73	21.08 ± 0.44
ICW	19.97 ± 2.26	20.23 ± 2.27	20.15 ± 2.54	22.83 ± 0.41

Our study findings were comparable with study done by Zalawadia AZ et al[11], Biswas A et al[12], Neelima P et al[13], Devi YE et al[14]. there was a noticed difference in morphometry parameters between different regions of India. MCAPD, LCAPD and ICW were more in sample from Andhra Pradesh, MCTD, LCTD were less among sample from AP when compared to our present study parameters. Most of Morphometric parameters from sample from West Bengal, were less than present study sample. These difference might be due to variance in selection of sample. There was a significant difference of Morphometric measurements of the lower end of the femur between male and females. (P value <0.05). our present study findings were consistent with study findings of Zalawadia AZ et al[11]. Morphometric parameters of distal femur were more among males than among females.

CONCLUSION

This study provides direct observational metrics of the distal femur, facilitating the selection of the suitable prosthesis. We have provided gender-specific and lateral statistics to improve prosthesis durability, mobility, and quality of life following knee replacement surgery.

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